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ABSTRACT

The United States-Japan Cooperative Science Program was initiated for the purpose of conducting research and exchanging ideas for the improvement of science education. A seminar was held in Honolulu in 1986 to discuss efforts and future directions of this cooperative program. This paper reviews the outcomes of the seminar in three areas. These include: (1) research (stating research questions as well as listing potential hypotheses); (2) teacher education (identifying the strengths, problems, and issues in pre-service and in-service training and possible future plans for collaboration); and (3) curriculum (outlining specific plans for a U.S. team and a Japanese and Korean team, with a projected timeline extending through 1990). (ML)

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United States-Japan Seminar on Science Educaton

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Seminar held in Honolulu, Hawaii, September, 1986.

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## Seminar Summary, Conclusions, and Recommendations

The participants were divided into three groups in an effort to study specific outcomes of the seminar. These three groups were (I) research, (II) teacher education, and (III) curriculum. The following is a summary of the three groups' discussions and recommendations.

I. Research (Spooner, Lawson, Renner, Staver, Takemura, Matsumoto)

Introduction: There is a need for more experimental research on cultural differences in logical thinking and process skills of middle grades students in the U.S., Japan, and Korea.

Primary Research Question: To what do we attribute the differences between North Carolina and Japanese middle grades students on logical thinking and integrated process skills tests?

A number of alternative hypotheses were suggested. They are listed below in the general order of importance given by the total group of participants:

1. Parental expectations between the two cultures are very different.
2. There are significant differences in the mathematics curriculum at the elementary and secondary levels between the two cultures.
3. There is more emphasis on experimentation, argumentation, reasoning, and problem-solving skills in Japan than is found in U.S. schools.
4. Time on task favors the Japanese students.
5. Philosophical and religious influences are very different in U.S. and Japanese schools.
6. Japanese science teaching techniques employ more open-ended and inquiry methods at the elementary school level than is found in U.S. schools.
7. Japanese elementary and secondary schools have superior science teaching laboratories and equipment used to teach science.
8. There is more emphasis on comprehension and logical understanding in teaching language arts.
9. Both in- and out-of-school TV viewing is related to the observed differences.

Other research questions:

1. Where and when do the measureable differences between U.S. and Japanese students begin?
2. How do the test results relate to achievement for both groups?
3. How do the test scores relate to the mathematics and science curriculum?
4. How do the score differences relate to measures of intelligence--mental capacity, cognitive styles, and spacial ability?
5. How do teachers differ in their abilities on logical thinking and process skills?
6. How do U.S. and Japanese students compare on logical thinking and process skills over a wider grade range (K-12)?

II. Teacher Education (Coble, Padilla, Blosser, Peterson)

This group studied the strengths, problems, and issues in pre-service training and in-service training.

Pre-Service Training

A. Strengths:

1. Japan: Admission to teacher education programs is open to everyone. All can benefit from training.
2. Japan: Rigorous exams at prefecture level control certification. Exams include written tests of knowledge and interviews which include individual and panel interviews. National average of teacher education graduates who are certified and actually teach in 10%.
3. Japan: Since 1949 there are national standards for training requirements.
4. Japan: Attached laboratory schools help connect theory and practice.
5. U.S.: Universities have entrance requirements for admission to teacher education programs, but admission varies between and within states.
6. U.S.: Most states have exit exams or requirements for certification.
7. U.S.: Flexibility and variability are a result of local control.
8. U.S.: Theory courses are connected to practice (field experience).

B. Problems and Issues:

1. Japan: Practice teaching is too short.
2. Japan: Non-teacher training system is inefficient for science teachers on philosophy, psychology, and methods of teaching science.
3. Curriculum of teacher training system is too subdivided into physics, biology, and chemistry, etc.
4. Japan and U.S.: Lack of meaningful communication between faculties of science and education.
5. U.S.: Need information on amount of science content needed by K-8 teachers.
6. U.S.: Inability to ensure that all teacher educators are up to date on current educational practices and research.
7. U.S.: Lack of evidence that teaching methods courses produces superior teaching.
8. U.S.: University faculty need to demonstrate better models of teaching.

C. Possible Future Plans for Collaboration:

1. Research on length of student teaching and outcomes.
2. Research on the effectiveness of pre-service and in-service training upon teacher performance and student achievement.

3. Teacher educators need to visit and study each other's pre-service and in-service programs and activities.
4. Produce descriptive comparative studies of U.S.-Japanese-Korean science teacher preparation.
5. Exchange pedagogical materials; seek support for translators.

In-Service Training

A. Strenghts:

1. Japan: There are many kinds of in-service training available at the national, prefecture, and local levels.
2. Japan: Each science education association has leadership in in-service training.
3. Japan: Demonstration lessons are given in some schools and frequently in Japanese elementary schools.
4. Japan: Career advancement exists for teachers.
5. U.S.: The teaching profession demonstrates commitment to continuous growth through in-service education programs.
6. U.S.: Funds for in-service training are increasing.
7. U.S.: Most states require renewal of teacher certification through coursework and staff development activities.
8. U.S.: Business and industry help provide in-service training for teachers in areas of specialization.

B. Problems and Issues:

1. Japan: Financial support is insufficient.
2. Japan and U.S.: In-service training is not systematic.
3. Japan and U.S.: University faculty involvement frequently ends when teachers are certified.
4. U.S.: Need career advancement opportunities.
5. U.S.: Need tangible rewards for good teaching.
6. U.S.: Quality control of providers is weak.

C. Possible Future plans for Collaboration:

1. Involve U.S. and Japanese scientists and science educators in exchange; important but very difficult in Japan.

III. Curriculum (Mattheis, Pottenger, Lee, Han, Oki)

As a result of the discussions during the seminar, it was decided that both the U.S. and Japanese teams would make an effort to secure funds from NSF and MOMBUSHO to continue a planned program of curriculum development and research. Some of the participants had developed local science curricula especially designed to promote thinking skills (Lawson and Renner), but these materials have not been used in other regions of the U.S. or Japan. Dr. Peterson developed a model for teaching thinking skills and used proportional reasoning as an example. This model is included in the Appendix. Both the U.S. and Japanese teams were very interested in studying

the curriculum materials especially designed to promote thinking skills. Dr. Pottenger is the senior author of the FAST (Foundationl Approaches to Science Teaching) which has recently been translated into Japanese. He is also a senior author of a new program in elementary school science which is being developed at the University of Hawaii. There is also a great deal of interest in evaluating these curricula in relation to the development of thinking skills. In addition, Dr. Padilla and his colleagues have recently developed some new tests that both teams were also very interested in using in the proposed research project.

The United States and Japan are presently both engaged in large-scale curriculum development projects. In the U.S., a number of projects for elementary and middle grades science curricula are in the process of being funded by NSF. Japan is presently developing a plan for revising its national curriculum in all areas, K-12, including science.

The group discussed various approaches to help improve teacher and student effectiveness in the general area of thinking skills and the appropriateness for use in both U.S. and Japanese schools and came up with the following general plan:

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| Oct. 1986-Feb. 1987 | Submit proposals to MOMBUSHO (Takemura) and NSF (Mattheis) to conduct a three-year study to improve reasoning skills in the U.S. and Japan (1987-90) |
| May 1987 | Conduct planning session. Cooperative team to begin three-year study (location to be decided) |
| May 1987 | Submit proposals to JSPS and NSF to conduct cooperative seminar in September 1988 to discuss progress during initial 15 months' work of three-year study |
| May 1987-Apr. 1990 | Conduct study to improve the thinking skills of U.S. and Japanese students. The four steps in this process are given below:<br>1. Survey new science curriculum in U.S. and Japan<br>2. Identify problem areas in NC-Japan study<br>3. Design lessons/activities or use appropriate new curriculum to address problems identified in #2<br>4. Evaluate to determine the effectiveness of these new strategies used to teach thinking skills |

## Plans for First Year of Cooperative Study (May 1987 - April 1988)

| U.S. Team | Japanese and Korean Team |
|---|---|
| 1. Identify problem areas in NC-Japan study | 1. Identify problem areas in NC-Japan study |
| 2. Survey new curriculum projects funded by NSF to identify the areas in #1 | 2. Survey new national curriculum to identify the areas in #1 |
| 3. Field test appropriate curriculum materials already developed by Lawson (grades 5 and 7) in at least five different states | 3. Translate Lawson's appropriate curriculum materials from grades 5 and 7 into Japanese and field test in selected laboratory schools in Japan |
| 4. Use Peterson's model for teaching proportional reasoning to develop appropriate lesson plans and field test these materials | 4. Translate Peterson's model into Japanese and develop lesson plans on topics from "national" curriculum to field test this model for teaching thinking skills |
| 5. Field test the FAST program in North Carolina and at least one other state | 5. Utilize the existing translation of FAST to field test for the development of thinking skills |
| 6. Use Padilla's (et.al.) tests to study the effectiveness of those curriculum | 6. Translate and utilize Padilla's tests |
| 7. Translate appropriate Japanese and Korean curriculum materials into English and field test in North Carolina and at least one other state | 7. Translate appropriate Korean curriculum materials into Japanese |

## Plans for Second Year of Cooperative Study (May 1988 - April 1989)

| U.S. Team | Japanese and Korean Team |
|---|---|
| 1. Continue development and field testing of curriculum materials started during the first year of the project | 1. Continue development and field testing of curriculum materials started during the first year |
| 2. Cooperative seminar in September '88 to share data and current status and plans for the completion of the study | 2. Cooperative seminar in September '88 to share data and current status and plans for the completion of the study |

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|---|---|
| 3. Continue evaluation plan to determine the effectiveness of teaching materials | 3. Continue evaluation plan to determine the effectiveness of teaching materials |

Plans for Third Year of Cooperative Project (May 1989 - April 1990)

| U.S. Team | Japanese and Korean Team |
|---|---|
| 1. Develop teacher training materials to assist pre-service and in-service teachers to effectively teach thinking skills | 1. Develop teacher training materials to assist pre-service and in-service teachers to effectively teach thinking skills |
| 2. Complete development and field testing of curriculum materials | 2. Complete development and field testing of curriculum materials |
| 3. Translate and field test additional Japanese and Korean materials | 3. Translate and field test additional U.S. and Korean materials |
| 4. Complete evaluation plan | 4. Complete evaluation plan |
| 5. Attend summary conference to discuss results of 3-year study | 5. Attend summary conference to discuss results of 3-year study |
| 6. Make recommendations for improving the development of thinking skills of Japanese and Korean students | 6. Make recommendations for improving the development of thinking skills of U.S. students |